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STARTER
[Sutaata]

MASAHIRO SOU

UNITED STATES PATENT AND TRADEMARK OFFICE
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SPECIFICATION

1. Title of the Invention

Starter

2. Claims

1. A starter characterized by being equipped with:

a starter motor [10] that rotates when energized with a battery [1];

a key switch [2] that is connected to one end of said battery and that energizes said starter motor;

a plunger [6] that moves when the key switch is turned on and that also moves a pinion that engages with the ring gear of the internal combustion engine;

a moving contact [7] that moves in response to the movement of the plunger;

fixed contacts, [8] and [9], that come into contact with the moving contact and that are provided between said battery and said starter motor;

multiple pull-in coils, [3] and [4], with about the same wire diameter that are wound in a cylindrical manner, that are connected to said key switch on one end, that are connected between said starter motor and said fixed contacts on the other end, that are connected in parallel to one another, and that suction said plunger when excited by being energized with said battery; and

a holding coil that has about the same wire diameter as those of the pull-in coils, that is provided in a cylindrical manner onto the inner periphery or outer periphery of said pull-in coils, that is connected to said key switch on one end and to the other end of the battery on the other end, and that becomes excited when energized with said battery and retains said plunger.

2. Starter of Claim 1 characterized by said pull-in coils and said holding coil being made up of one strand of a wire material.

3. Detailed Explanation of the Invention

[Field of Industrial Application]

The present invention pertains to improvements in starters, specifically to improvements in pull-in coils of magnet switches.

[Prior Art]

Conventionally, a pull-in coil [3] and a holding coil [5] are energized from a battery [1] by closing a key switch [2], and current runs in parallel as shown in Fig. 3. Then, by a plunger [6] being suctioned, a moving contact [7] provided to the front end [6a] of the plunger [6] moves in an interlocking manner and comes into contact with fixed contacts, [8] and [9]. This allows current to run to a motor [10] and the motor [10] to rotate.

At this time, since the current runs through the fixed contact [8], moving contact [7], and fixed contact [9], no current runs in the pull-in coil [3] and the current runs only in the holding coil [5] (as

mentioned, for example, in Jikkai No.56-77647).

Since the pull-in coil [3] runs a large current instantaneously and obtains a force to suction the plunger [6], one with a large wire diameter is used for it.

Moreover, since the holding coil [5] only needs to retain the plunger [6] in a suctioned state, one with a small diameter is used for it.

In other words, the air gap between the moving contact [6a] and the fixed contacts, [8] and [9], becomes eliminated (the magnetic resistance decreases), and therefore, only a relatively week magnetic force is required for the retention.

[Problems that the Invention is to Solve]

However, the pull-in coil [3] and holding coil [5] are conventionally wound around the same bobbin [11], and the holding coil [5] is wound around as the upper layers of the pull-in coil [3], which has the large wire diameter.

In other words, the holding coil [5] is wound around the bobbin [11] as it drops between each wire of the pull-in coil [3]. For this reason, if the gap between the wire diameter of the pull-in coil [3] and the wire diameter of the holding coil [5] becomes large, the wire intervals [x] of the second and later layers of the holding coil [5] increase, and the winding of the second and later layers becomes random.

Therefore, there was a problem in that the maximum outer diameter of the coil became large when compared to aligned winding that has no distortions, and a large coil space had to be secured.

Moreover, since the number of windings of the holding coil [5] is constant, there was also a problem in that random winding of the holding coil [5] makes the lengths of the windings of the holding coil [5] uneven and the resistance tolerance higher.

To solve the above problems, the purpose of the present invention is to allow each coil to be wound in alignment reliably.

[Means for Solving the Problems]

A structure is utilized in which mutually parallel-connected multiple pull-in coils that are wound in a cylindrical manner and that have approximately equal wire diameters and a holding coil that has about the same wire diameter as the pull-in coils and that is provided in a cylindrical manner to the outer periphery or inner periphery of the pull-in coils are equipped.

Furthermore, a structure in which the pull-in coils and holding coil are made from one strand of wire material is utilized.

[Operation of the Invention]

By connecting multiple pull-in coils to one another in parallel, the wire diameters of the pull-in coils can be reduced, the wire diameters of the pull-in coils and holding coil become approximately equal, and the wire intervals between the coils of the wound pull-in

coils and holding coil become equal.

[Effects of the Invention]

Thus, the holding coil and pull-in coils do not become wound at random at the time of winding, and aligned coils without distortions can be obtained.

Therefore, by the coils being aligned, the maximum outer diameter of the wound coils becomes small and the lengths of the coils become almost constant, and therefore, the resistance tolerance is mostly eliminated.

Moreover, since the pull-in coils and holding coil are made up of one strand of a wire material, simplification can be achieved with respect to the equipment and man-hours related to coil winding.

[Working Example]

In the following, one working example of the starter of the present invention will be explained based on drawings.

In Fig. 1, [1] is a battery, and a key switch [2] is connected to the (+) side of this battery [1].

By means of this key switch [2], later-described pull-in coils, [3] and [4], and a holding coil [5] are connected to the (+) side of the battery [1].

[6] is a plunger, and it becomes suctioned by one end of the pull-in coils, [3] and [4], and the holding coil [5] being excited.

By the plunger [6] being suctioned, a pinion that engages with the ring gear of the internal combustion engine moves to the ring gear side by means of a shifting lever, not shown in the figure.

The front end [6a] of the plunger [6] is provided with a moving contact [7], and fixed contacts, [8] and [9], are provided in a manner such that the moving contact [7] can come into contact with them.

The fixed contact [8] is connected to the (+) side of the battery [1], and the fixed contact [9] is connected to a starter motor [10].

The other ends of the pull-in coils, [3] and [4], are connected between the fixed contact [9] and starter motor [10].

The operation of the above structure will be explained.

When the key switch [2] is closed, the pull-in coils, [3] and [4], and holding coil [5] become energized by the battery [1] and become excited. By each coil being excited, the plunger [6] becomes suctioned, and the pinion moves to the ring gear side by means of the shifting lever. Moreover, by the plunger [6] being suctioned, the moving contact [7] comes into contact with the fixed contacts, [8] and [9].

At this time, the current runs only in the holding coil [5], and the moving contact [7] is retained only by the holding coil [5] and is in contact with the fixed contacts, [8] and [9].

By the moving contact [7] being in contact with the fixed contacts, [8] and [9], the starter motor [10] becomes energized by the

battery [1]. This energizing rotates the starter motor [10], and by the pinion turning by means of a rotary shaft, not shown in the figure, the ring gear turns and the internal combustion engine is started.

After the internal combustion engine is started, the key switch [2] is opened and the current running in the holding coil [5] becomes shut off. Therefore, the moving contact [7] returns to its original location by means of a return spring, not shown in the figure.

Next, the pull-in coils, [3] and [4], and the holding coil [5] will be described in detail.

As shown in Fig. 2, a pull-in coil [3] is first wound sequentially around the outer periphery of a bobbin [11] in 3 layers from the bottom side of the figure. Next, a pull-in coil [4] having approximately the same wire diameter as that of the pull-in coil [3] is sequentially wound around the outer periphery of the pull-in coil [3] in 3 layers from the bottom side of the figure with the number of windings being almost the same as that of the pull-in coil [3]. Lastly, a holding coil [5] having approximately the same wire diameter as those of the pull-in coils, [3] and [4], is wound around the outer periphery of the pull-in coil [4] in 2 layers from the bottom side of the figure. The coils are wound in that order by taking into consideration the ease of coil winding.

Moreover, at the time of the winding of the pull-in coils, [3] and [4], and the holding coil [5] around the bobbin [11] as one strand of wire material, the portion that will be the terminal is drawn out after winding the pull-in coil [3], and then the pull-in coil [4] is wound as the upper layer of the pull-in coil [3]. Then, after winding the pull-in coil [4], the portion that will be the terminal is drawn out. Then, the holding coil [5] is wound as the upper layer of the pull-in coil [4]. Lastly, each drawn-out portion that will be a terminal is treated.

Therefore, the winding process can be performed in one process and the man-hours can be reduced.

The wire diameter of the holding coil is about 0.65mm. Moreover, since a conventional pull-in coil needs to run a large amount of current instantaneously, its wire diameter is about 0.9mm and the cross-sectional area is about $0.63mm^2$.

According to the present invention, by making one strand of a conventional pull-in coil into two strands of parallel-connected pull-in coils, [3] and [4], the wire diameters of the pull-in coils, [3] and [4], can be made to be about 0.65mm and equal to the wire diameter of the holding coil [5].

The wire diameters of the pull-in coils, [3] and [4], become small and the cross-sectional areas of the pull-in coils, [3] and [4], become about $0.332mm^2$, but since the pull-in coil [3] and pull-in coil

[4] are connected in parallel, the cross-sectional area becomes $0.332 \times 2 = 0.664 mm^2$.

Therefore, a cross-sectional area that is equal to the conventional one can be secured, and thus, there is no effect on the suction force for the plunger [6].

Moreover, the wire diameter allowances of the pull-in coils, [3] and [4], and holding coil [5] were excellent up to about ±15% as a result of winding tests conducted by the present inventor (provided that the wire diameter of each coil was about 0.65mm).

Thus, it is possible to make the wire diameters of the coils the same, and therefore, the wire intervals [y] between the coils are equal to the diameter of each coil and the pull-in coil [4] that is wound as the upper layer of the pull-in coil [3] will not drop between the wires of the pull-in coil [3]. Moreover, the holding coil [5] that is wound as the upper layer of the pull-in coil [4] will not drop between the wires of the pull-in coil.

Therefore, the pull-in coil [4] and holding coil [5] that are wound as the upper layers of the pull-in coil [3] will not be wound at random, but in alignment. Therefore, the distance from the center of the bobbin [11] to the outer periphery of the holding coil [5] becomes constant, and the size of the bobbin [11] can be made to be minimal.

Moreover, by reducing the wire diameters of the pull-in coils, the dead space generated between the wires can be reduced by winding

the pull-in coils around the bobbin.

In the above manner, the size of a starter can be reduced while keeping the performance equal to that of the past.

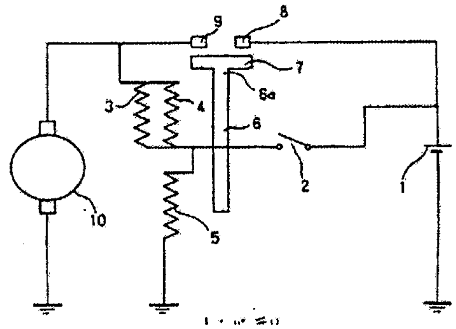
Moreover, since the wire diameters of the coils are equal, coils of the same diameter can be utilized, and the equipment used for coil winding can be simplified.

4. Brief Explanation of the Drawings

Figure 1 is an electrical circuit drawing showing the essential parts of the starter of one working example of the present invention; Figure 2 is a cross-sectional drawing of the essential parts that shows a state in which the pull-in coils and holding coil of the above starter are wound around a bobbin; Figure 3 is an electrical circuit drawing showing the essential parts of a conventional starter; and Figure 4 is a cross-sectional drawing of the essential parts that shows a state in which the pull-in coil and holding coil of a conventional starter are wound around a bobbin.

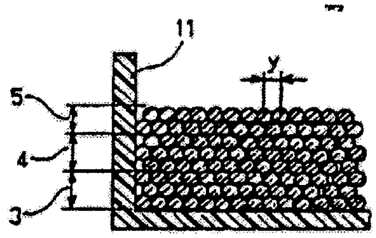
[1] = battery; [2] = key switch; [3],[4] = pull-in coil; [5] = holding coil; [6] = plunger; [7] = moving contact; [8],[9] = fixed contact; [10] = starter motor.

Figure 1



1: battery;
2: key switch;
3,4: pull-in coil;
5: holding coil;
6: plunger;
7: moving contact;
8,9: fixed contact;
10: starter motor.

Figure 2



3,4: pull-in coil;
5: holding coil.

Figure 3

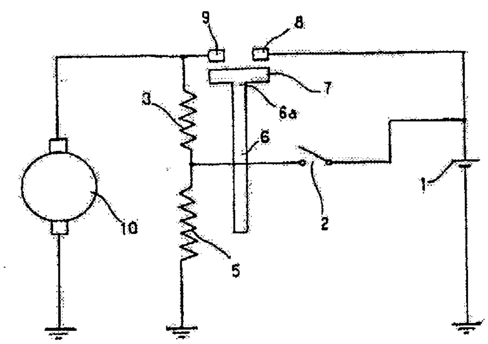


Figure 4